Ketterson / Nolan Research Group Collection

This document is part of a collection that serves two purposes. First it is a public archive for data and documents resulting from evolutionary, ecological, and behavioral research conducted by the Ketterson-Nolan research group. The focus of the research is an abundant North American songbird, the dark-eyed junco, *Junco hyemalis*, and the primary sources of support have been the National Science Foundation and Indiana University. The research was conducted in collaboration with numerous colleagues and students, and the objective of this site is to preserve not only the published products of the research, but also to document the organization and people that led to the published findings. Second it is a repository for the works of Val Nolan Jr., who studied songbirds in addition to the junco: in particular the prairie warbler, *Dendroica discolor*. This site was originally compiled and organized by Eric Snajdr, Nicole Gerlach, and Ellen Ketterson.

Context Statement
This document was generated as part of a long-term biological research project on a songbird, the dark-eyed junco, conducted by the Ketterson/Nolan research group at Indiana University. For more information, please see IUScholarWorks (https://scholarworks.iu.edu/dspace/handle/2022/7911).

Sex differences in the liver: transcriptional responses to testosterone in a wild songbird

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Introduction

·Testosterone (T)[1]:
- · Increases short-term efforts (e.g., aggression, courtship) &
- · Decreases long-term efforts (e.g., immune, parental)
- · Generally, increases activity and current energy demand
- · Males and females respond to T in different ways[2]

·The liver:
- · Coordinates metabolism and glucose exchange & storage
- · Sexually dimorphic (e.g., immune response)[3]
- · Responds to T in adolescence[4] and as adults[2]

·Genomic paths mediating liver dimorphism and T response currently remain unclear in wild animals[5,6]

·Males and females share genomes, so dimorphism must be explained by differences in gene expression[7]

Questions

·How does T affect gene expression in the liver?

·Does exogenous T masculinize gene expression?
- · Does T affect males and females in the same manner?

Dark-eyed Junco

·Seasonally breeding sparrow
·Extensively studied breeding biology[8]
·Many previous T implant studies[1]
- · Both free-living and captive
- · Implants reliably elevate T
- · T affects sexually dimorphic behaviors

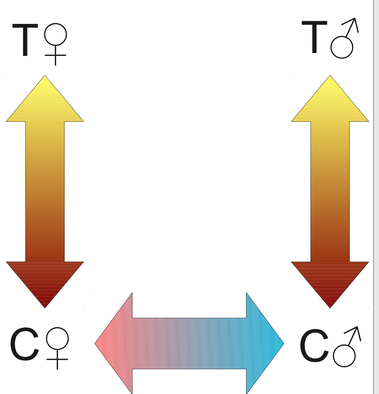
·Natural variation in T is correlated with dimorphic physiology and behavior[8]

Experimental Design

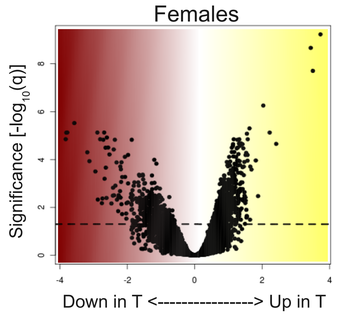
·12 males and 12 females
- · Wild caught
- · half T implants
- · half empty implants

·Collected tissue at 3 weeks
·Compared gene expression
- · Junco microarray[9]
- · 6 biological replicates

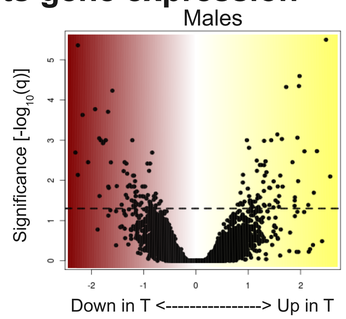
·Analyzed using limma[10] in R
·False discovery rate[11] q<0.05
·Functional analysis for Gene Ontology[12] (GO) enrichment analysis in BiNGO[13]



Testosterone affects gene expression

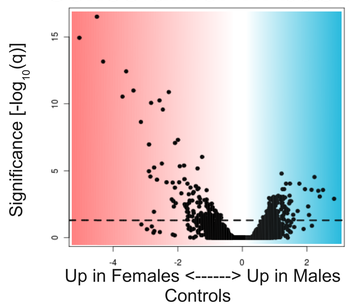


Functional (GO) Categories
- Cell signaling
- Protein catabolism
- Immune function
- Cell localization

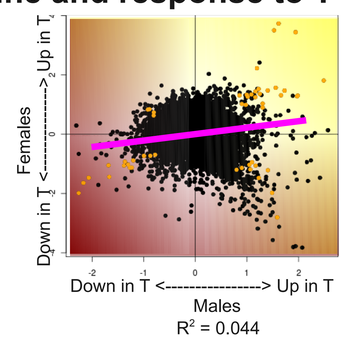


Functional (GO) Categories
- Muscle development
- Immune function

Sexes differ in baseline and response to T



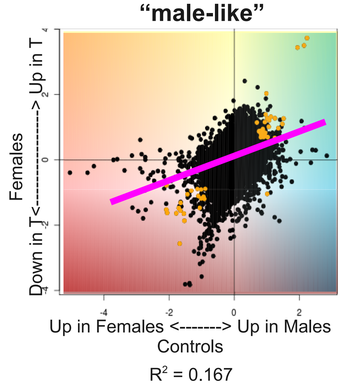
Functional (GO) Categories
- Cell communication
- Immune function
- Muscle Development



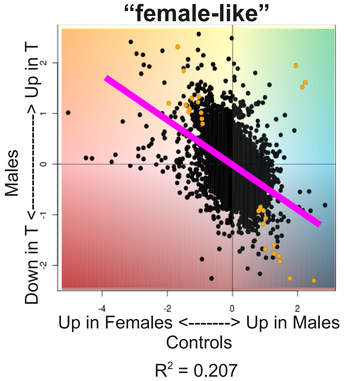
- Only 52 (of 149 male and 1311 female) contigs are significantly differentially expressed in both (orange points)

T affects sexes differently

Makes females more "male-like"



Makes males more "female-like"



Conclusions

·T affects gene expression
- · Large impact on female gene expression
  - · Changes cell signaling pathways (up and down)
  - · Increases expression of immune genes
  - · Changed cell localization (up and down)
- · Moderate impact on male gene expression
  - · Impacted smaller number of genes, less specific
  - · Increased muscle development expression
  - · Increased immune function

· Sexes differ in gene expression at baseline
- · Many more genes (and greater magnitude) female biased
  - · Possibly due to sex linked genes
- · Immune function genes higher in females
- · Muscle development up regulated in males

· T affects the sexes in different ways
- · Weak correlation between effects shows that different genes are responding in each sex
- · Difference in direction suggests that T is sufficient to masculinize adult female gene expression, but appears to feminize adult male gene expression

Future Directions

·Are the sex biased genes located on the sex chromosomes?
·How does T affect gene expression the brain and other organs?
·How does natural variation in T affect gene expression?

Acknowledgments

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